Procedures are a part of our everyday lives. Individuals and organizations utilize them as a way to assure that a task is performed in a thorough and predictable manner each time it is needed.

Computers also use procedures in this manner. Procedures encode the operations needed to accomplish a task. In other words, procedures encode algorithms.

**Importance of Procedures**

❖ Procedures encapsulate functionality (useful instruction) so that it can be used anywhere, anytime.

❖ Procedures help manage complexity
  ❑ If you find yourself writing the same code statements multiple times in your program, this is a good indication that you need a procedure to minimize the amount of code.

**A Simple Scenario**

❖ We use email every day to send mail to friends in the state, across the country or around the world.

❖ You receive mail from your friend in Australia telling you it’s 38°C

❖ The temperature is Celsius, but you want Fahrenheit

❖ You could do a quick calculation, but since you write to this person a lot, it would be better to just write a little procedure to do the calculation every time.

**Structure Of A Procedure**

❖ Procedures encapsulate (package up) a computation to be used anywhere, anytime

❖ Procedures have the following features:
  ❑ Name: term used to refer to the task the procedure performs, example: convertC2F
  ❑ Definition: The steps that will accomplish the task. Also known as the procedure body
    tempInF = 9*tempInC / 5 + 32
  ❑ Parameters: the names of the input data and the output results
    tempInC As Integer, tempInF As Integer
  ❑ Declaration: the entire package of the name, definition and parameters
The Whole Procedure Package

- Procedure Declaration: Includes name, definition and parameters

```
Private Sub ConvertC2F (tempInC As Integer, tempInF As Double)
    tempInF = 9 * tempInC / 5 + 32
End Sub
```

You Have Already Seen Procedures!

- The event handling routines that you have manipulated with code (i.e. the click events) are procedures

- The Private Sub part of the procedure is a reference to the old name for procedures within a program: Sub Routines, shortened to Sub in the program language notation
  - Private Sub cmdOK_Click()
    End Sub

- Every time a user activates a control, i.e. clicks a command button, VB calls the procedure needed: the event handling routine

Calling A Procedure

- The procedure declaration only specifies how the procedure works and only needs to be given once

- The procedure call says when, where and with what values the procedure will be performed (executed)
  - A procedure call can be used anywhere that the task to be performed is needed

- Call convertC2F (38, degreesF) is a VB procedure call specifying the procedure to be executed (convertC2F) and the values to be used (38 is the Celsius temperature input and degreesF is the variable for the result)

Parameter Correspondence

- The parameters name the input values and the output results to the procedure

- The number of parameters in the declaration must match the number of parameters in the call, and they correspond one-to-one

- The parameters are referred to by separate names
  - Formal parameters are parameters of the declaration
  - Actual parameters are parameters of the call

```
Call convertC2F (38, degreesF)
```
What Happens…

❖ A procedure call “makes it happen”
❖ Substitution Rule: The procedure call operates as if the definition replaces the call and the actual parameters replace the formal parameters

```vbnet
Private Sub ConvertC2F (tempInC As Integer, tempInF As Double)
    tempInF = 9 * tempInC / 5 + 32
End Sub
```

Call the convertC2F Procedure

```vbnet
Private Sub cmdConvert_Click()
    Dim degreesC As Integer
    Dim degreesF As Double
    degreesC = txtTempC.Text
    Call ConvertC2F(degreesC, degreesF)
    lblTempF.Caption = "That is " & degreesF & " degrees Fahrenheit"
End Sub
```

Procedural Abstraction

❖ Whenever the same operations are performed in different places in a program, there is an opportunity for procedural abstraction
❖ Procedural abstraction gives a name to the operations
❖ It also encapsulates the operations so they can be executed out-of-view, receiving input via parameters and returning results or creating effects at the point of the call

Let’s Implement Wednesday’s Design

❖ You had to design an application that would take in the temperature from the user
❖ The program then gave and “opinion” about the temperature outside
❖ In addition, the program did a conversion of the temperature entered into Celsius
❖ The programming constructs involved are
  ❖ variables (local and global),
  ❖ conditionals
  ❖ procedures
**Mini-Exercise #1**

What is the value of \(x\) after the form has been loaded?

```vba
Option Explicit
Dim x As Integer
Private Sub squid()
    x=x+2
End Sub
Private Sub Form_Load
    x=0
    Call squid
End Sub
```

**Mini-Exercise #2**

What is the value of \(y\) after the form has been loaded?

```vba
Option Explicit
Dim y As Integer
Private Sub squid()
    y=y+2
End Sub
Private Sub clam()
    Call squid
    Call squid
End Sub
Private Sub Form_Load
    y=0
    Call squid
    Call clam
End Sub
```

**Summary**

- Procedure declarations encapsulate name, parameters and definition
- Procedure calls cause the procedure to be executed
- Parameters must match in number and order
- The Substitution Rule defines how procedures work